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Studying slip system activity in deforming single crystals using high-energy X-ray diffraction

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ABSTRACT

High-energy X-ray diffraction microscopy experiments can be used as an effective tool to observe changes of lattice state in crystalline materials as plastic deformation proceeds. The evolution of diffracted intensity distributions measured during the plastic deformation of a crystal is directly related to the underlying distributions of lattice orientation and strain. These distributions of orientation and strain are closely linked to heterogeneities of the deformation across a crystal. Our current study focuses on how developing diffracted intensity distributions can be related to slip system activity. New data analysis methods will be presented which use Nye's model of heterogeneous slip to link slip system activity with evolution of diffracted intensity distributions caused by increasing misorientation. These data analysis methods are tested using diffraction data measured in situ during plastic deformation of silicon single crystals oriented for single slip at the elastic-plastic transition.